Final Projects Overview

Machine Learning for Image Processing
COEN 4890 / EECE 5890

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October 23, 2018

Borrowed from http://www.cs.washington.edu/education/courses/cse446/

Final Projects

- Hands-on Applications of Machine Learning Algorithms to Image Processing
  - Automatic Target Recognition (ATR) for CT-based Airport Checkpoint Screening
  - Bring your own ideas/data (BYOI)

- Projects can be done by teams of two or three students.
  - Group by 10/26 (Friday)
  - If you don’t find your group mate by then, I will assign the group.

Final Projects: Grading

- The final project is worth 25% of your final grade, which will be split amongst two deliverables:

1. Oral presentation on 12/4 (Tuesday) 5:30pm~8:00pm (10% of your final grade)
   - 15-minute presentation + 10-min Q&A
   - Pizza will be served ☺
2. Conference-paper style final report by 12/14 (Friday) (15% of your final grade)
   - Latex: Overleaf
   - 4 page limit including title, abstract, and references
   - Supplementary files: Codes

Final Projects: Grading Criteria

- Technical Depth: How technically challenging was what you did?
- Scope: How broad was your project? How many aspects, angles, variations did you explore?
- Presentation: How well did you explain what you did, your results, and interpret the outcomes? Did you use the good graphs and visualizations? How clear was the writing?

Final Projects: Final Reports

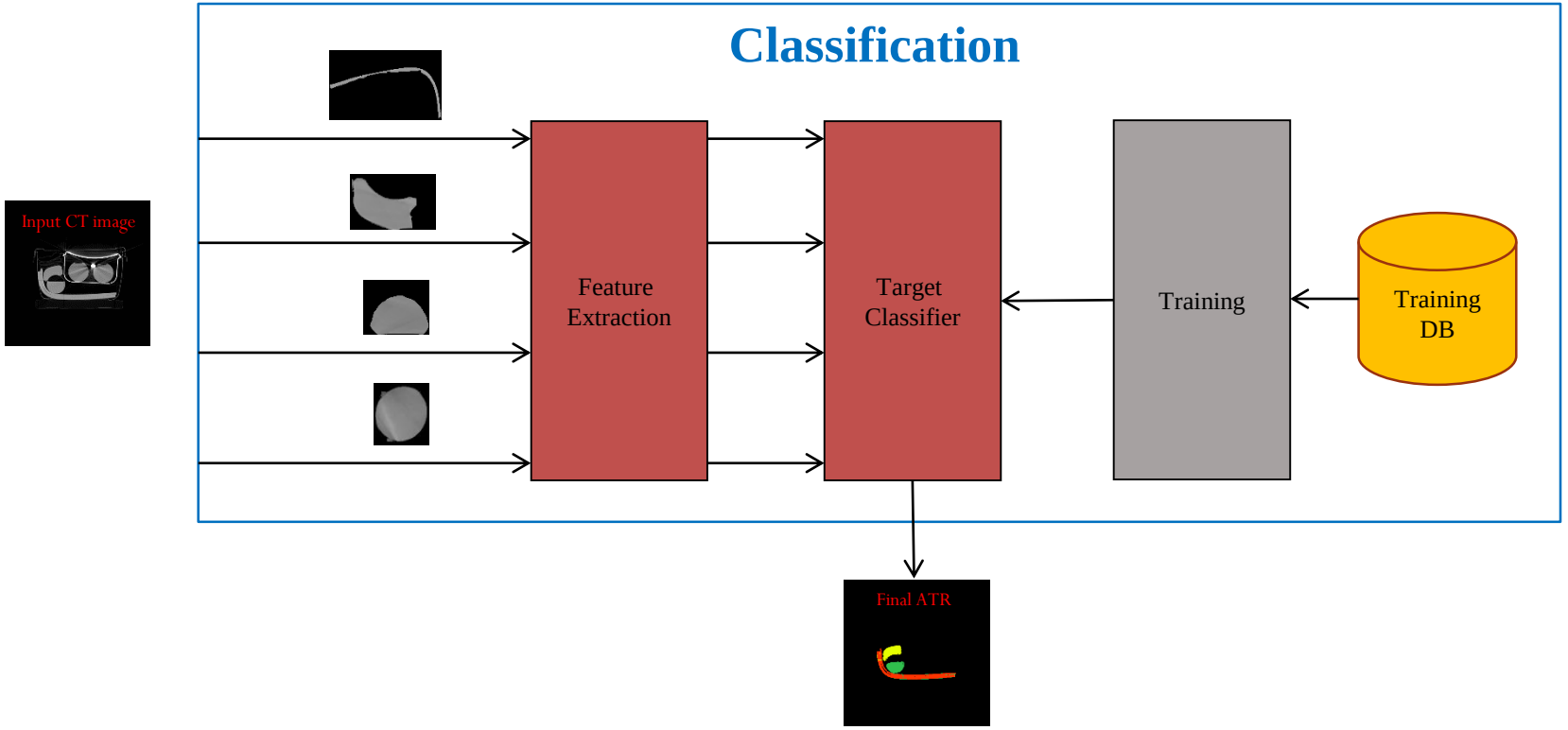
- Overleaf: https://www.overleaf.com

- IEEE Conference Template in D2L
  - 2 Column + 4 pages including references

- Guideline
  - Title + Author List + Institution
  - Abstract: max 250 words
  - Introduction: Literature Review + Highlight/Novelty
  - Methods: What you have done? (Equations)
  - Experimental Results: Tables + Figures/Illustration, Interpretation
  - Conclusion: One paragraph summary (+ Future work)

Final Projects: ATR

- Automatic Target Recognition for CT-based Airport Screening System



Final Projects: ATR-Targets

- Saline
  - 3.5%, 10%, 15% concentrations
  - Container not part of target; only the saline
- Modeling (polymer) clay
- Rubber sheets: ¼” thickness (minimum) + other rubber in bags

Final Projects: ATR-Non Targets

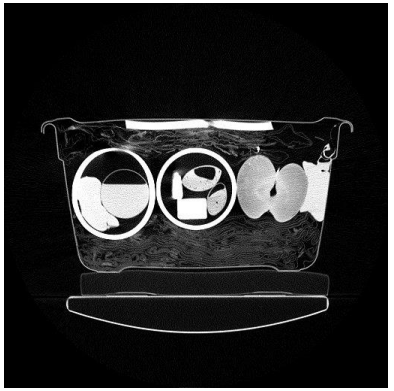
- Stream of commerce items
  - Food
  - Drinks
  - Electronics
  - Magazines

- Containers for liquid filled with saline and non-targets (e.g., water)

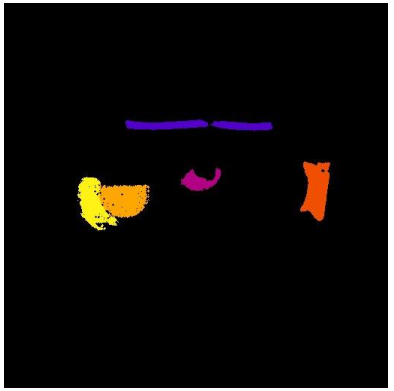
Final Projects: ATR-Resource

- Packing: Targets packed with a plastic bin

- Scanning: Scan on medical CT scanner

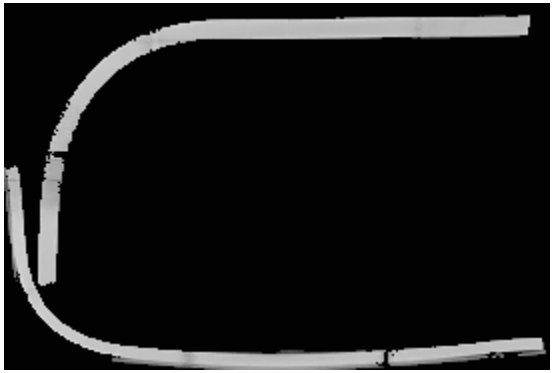


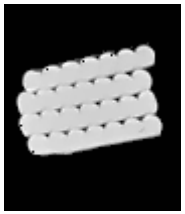
- Ground-Truth: Only for targets



Final Projects: ATR-Your Dataset

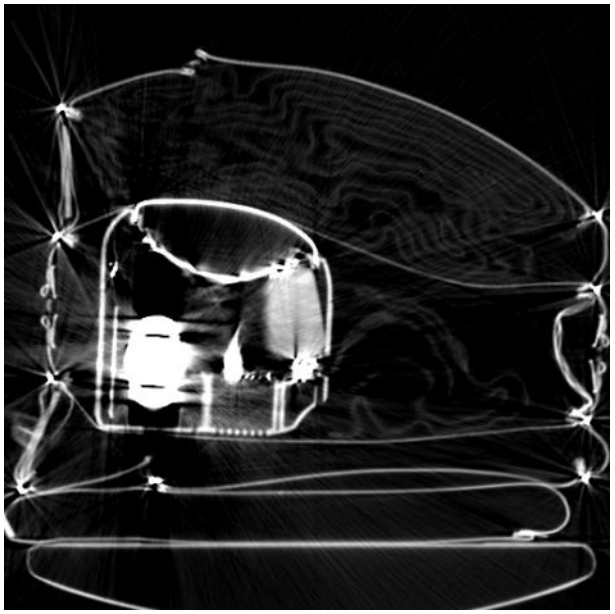
- CT image: Cropped CT images for each segmented object





- Target Label: 0: Non-Target, 1: Saline, 2: Rubber, 3: Clay
  - Training: Target Labels are given
  - Testing: Target Labels are **NOT** given

Final Projects: ATR-Typical Image Quality



- Artifact types
  - Shading
  - Streaks
  - Noise
  - Blurring
  - Rings
- Artifacts lead to
  - Imprecise density, volume, mass, shape

How are IQ issues handled in ATR in terms of robustness?

Final Projects: ATR-Features

- Mass
- Mean
- Standard deviation
- Histograms
- Higher-order moments
  - Skew, kurtosis, entropy
- Texture
  - Wavelets

Your responsibility to determine relevant features

Final Projects: ATR-Classifier

- PCA
- SVM
- Decision Tree
- Adaboost
- Deep neural network
- …

Your responsibility to develop the best classifier

Final Projects: ATR-Performance Metric

- PD = # targets detected / # targets scanned
- PFA = # false alarm objects / # non-targets scanned

- PD > 90%, PFA < 10%

- Cross-Validation on Training
- Hold-out on Testing
  - Blind Evaluation: You provide the label and I give the number!

Final Projects: ATR-Visualization

- Nifti file format: Standard Neuroimaging File Format
- .nii.gz: gzipped image
- Matlab tool for Nifti: load_nii.m
  https://www.mathworks.com/matlabcentral/fileexchange/8797-tools-for-nifti-and-analyze-image
- MATLAB 2018b: readnifti.m
- Python: PyNifti
  http://niftilib.sourceforge.net/pynifti/
- Visualization: MIPAV
  https://mipav.cit.nih.gov/

Final Projects: BYOI

- You have to make sure you have the data available now and a nice roadmap, since time is too short to explore a brand new concept.

- You can discuss your ideas with me, but of course the final responsibility to define and execute an interesting piece of work is yours.

- Submit 1-page Project Proposal by 10/30 (Tuesday)
  - Project title, Data set
  - Project idea description (2 paragraphs)
  - Teammate, Milestone
  - Software you will need to write.